

said abrasive liquid composition is an aqueous acid suspension, having a pH of 1-5, of

(i) individualized colloidal silica particles not linked to each other by siloxane bonds,

together with (ii) a surfactant,

wherein said abrasive liquid composition is substantially free of other components.

REMARKS

The Official Action of September 25, 2002, and the prior art cited and relied upon therein have been carefully reviewed. The claims in the application are now claims 17-40, and these claims define patentable subject matter warranting their allowance. Accordingly, applicants respectfully request favorable reconsideration and allowance.

New claim 40 has been added. It is similar to claim 37 as regards the substantial exclusion of significant ingredients from the acid aqueous suspension other than the recited components. It moreover specifies that the layer being rubbed according to the process constitutes one layer of silicon oxide and another layer of silicon nitride. Support should be clear; however, in view of the criticism of claim 37, discussed below, applicants respectfully note that the composition is fully consistent with applicants' examples.

Claim 40 is patentable for the same reasons as are claims 17-39, as pointed out below.

Claim 37 has been rejected under the first paragraph of §112. The rejection is respectfully traversed.

Claim 37 is clearly supported by the examples, and particularly the composition as disclosed at page 9, lines 11-18. No components other than the ones recited are disclosed. The other examples also support claim 37 which recites the use of an abrasive liquid composition which consists essentially of an acid aqueous suspension of (i) the specified silica particles and (ii) a surfactant.

As the rejection is unsupportable, applicants respectfully request its withdrawal.

Claims 17-39 have been rejected as obvious under §103 from Jacquinet in view of newly applied Grover et al USP 5,759,917 (Grover), which is acknowledged prior art mentioned in applicants' specification at page 2, lines 16-22. The rejection is respectfully traversed.

Grover is closer prior art in some respects than any prior art previously applied, in that it at least is concerned with the same or similar problems as faced by the applicants. However, it teaches those of ordinary skill in the art to proceed in a way which is **different** from the present

invention, and it therefore teaches away from the present invention for the reasons to be pointed out below.

First, however, applicants would like to review important features of the present invention.

The present invention relates to a process for mechanical chemical polishing of silicon oxide and/or silicon nitride surfaces, or low dielectric polymer surfaces, wherein an abrasive liquid composition comprising an aqueous acid suspension of:

- 1) individualized colloidal silica particles not linked to each other by siloxane bounds and

- 2) a surfactant

is used (specification page 1, lines 6-10; page 6, lines 3-10 and claim 17).

Under preferred conditions of implementation of the invention, the pH of the composition is between 1 and 5, preferably between 2 and 3 (page 5, line 30 and page 7, line 1, claims 20-22 and 23-25).

As far as the size of the particles is concerned, a preferred average diameter of the individualized abrasive particles is between 12 and 100 nm, preferably between 35 and 50 nm (page 6, lines 20-22, claims 20-22 and 23-25).

The surfactant is preferably non-ionic or anionic (page 7, lines 20-26, claims 18-19), preferably the latter.

As regards the concentration of the silica particles, it is preferably between 25% and 35% (page 7, line 5, claims 28-30).

The volumetric concentration of the surfactant in the aqueous suspension is between 0.001% and 5% (page 7, line 14, claims 31-33), and more preferably between 0.001% and 1% (page 7, claims 34-36).

In the present invention, the use of a surfactant in the aqueous liquid suspension allows the polishing speed of the silicon nitride to be reduced very considerably while maintaining the polishing speed of the silicon oxide at a sufficient level.

A selective polishing of the silicon oxide related to the silicon nitride is thus obtained. As stated above, the use of the surfactant further allows the polishing speed of polymers with a low dielectric constant to be increased very considerably.

Jacquinet discloses a method of chemical mechanical polishing of electric isolation material using an acid aqueous suspension of colloidal silica containing individualized colloidal silica particles, not linked together by siloxane bonds, and water as the suspension medium. Abrasion is carried out by rubbing the layer in question using a fabric

which has been impregnated with the acid aqueous suspension of colloidal silica.

Consistent with the process of the present invention, the particle size of the silica particles is in Jacquinot between 3 and 250 nm, preferably between 3 and 150 nm, and most preferably between 10 and 50 nm.

In addition, the pH is between 1 and 6, preferably between 1.5 and 4 and most preferably between 2 and 3.

However, no mention is made in Jacquinot of the polishing of materials formed of one layer of silicon oxide and another layer of silicon nitride, in which the problems exist which necessitated the present invention.

Most importantly, and as acknowledged by the PTO, Jacquinot does not disclose or suggest the presence of the surfactant in the liquid abrasive composition which is impregnated into the fabric used for rubbing the surface to be polished.

Unlike Jacquinot, Grover is concerned with the same or similar problems faced by the present applicants. As stated in the first paragraph near the top of column 1, Grover indicates that its invention concerns a chemical mechanical polishing (CMP) "slurry have a unique chemistry that is especially suitable for chemical mechanical planarization where a high silicon dioxide removal rate, and a low silicon

nitride removal rate required on the same substrate." Compare the background section of Grover with the background section of the present application, and also please note the objectives set forth in Grover at column 2, lines 22-31, especially the third such statement as follows:

..., this invention is a method using a chemical mechanical polishing composition that selectively removes silicon dioxide from a substrate while leaving a silicon nitride layer associated with the substrate essentially intact.

In this regard, the objective and teaching of Grover is to provide a CMP slurry that has a greater than a 5 to 1 oxide to nitride selectivity (column 2, line 8-10).

To accomplish its objectives, Grover teaches a method for using a chemical mechanical polishing composition comprising carboxylic acid, a salt and a soluble cerium compound in an aqueous solution having a pH from about 3.0 to about 11, preferably from about 3.8 to about 5.5 (column 6, lines 31-34), to selectively remove silicon oxide overfill in preference to a silicon nitride film layer (column 2, lines 47-50).

The chemical mechanical polishing composition may be used alone or it may be combined with a metal oxide abrasive to form a slurry (column 2, lines 61-63). The optional metal oxide (which may or may not be added to the CMP composition) may be selected from the group including alumina, titania,

zirconia, germania, silica, ceria and mixtures thereof (column 4, lines 22-24).

In preferred embodiments of Grover in which an abrasive slurry is added to the composition, pulverized cerium oxide (column 4, lines 46-54), precipitated cerium oxide (column 5, lines 3-10) or fumed silica (column 5, lines 11-25) are mentioned as metal oxide abrasives. Discrete metal oxide particles having a particle diameter less than 500 nm are cited (column 5, lines 56-59), but there is no working example and no details are given about the type of discrete particles.

Grover also discloses the optional use of surfactants (column 6, lines 37-64). However, surfactants are only one variety of additional optional additives. Further, the function of the optional surfactant is to improve stability of the polishing slurry, i.e. against settling, flocculation and decomposition of the oxidizing agent (column 6, lines 37-39) or to improve steric stabilization of the slurry (column 6, lines 49-54). Moreover, addition of a surfactant may improve the within-wafer-non-uniformity (WIWNU) of the wafers. However, not a single one of the 34 slurries of Grover shows the use of a surfactant in the slurry.

Considering next the proposed combination, one must first ask what the person having ordinary skill in the art would do, faced with applicants' problem and reading Jacquinet

and Grover together. As Grover seeks to solve the same problems (or similar problems) faced by the applicants, the person of ordinary skill in the art facing the same problems would be strongly guided by Grover, and less guided by Jacquinot. What then does Grover absolutely require in order to accomplish the objective of greater than a 5 to 1 oxide to nitride selectivity so as to selectively remove silicon dioxide while leaving silicon nitride essentially intact? The answer is clear! Grover absolutely requires (1) a carboxylic acid, (2) a salt, and (3) a soluble cerium compound¹. The presence or absence of a surfactant is unimportant.

The person skilled in the art seeking to obtain the present results would have had no incentive to combine both references (Jacquinot and Grover).

To accomplish the desired objectives, the person of ordinary skill in the art is guided by Grover to use a polishing slurry which critically contains a carboxylic acid, a salt, and a soluble cerium compound, and it is stated at the bottom of column 2 that such a composition has "been found to inhibit silicon nitride polishing". Therefore, these ingredients must be incorporated, and their inclusion is contrary to the present invention. In effect, applicants have

¹ The pH is less important, as it may be anywhere between "about 3.0 to about 11" (column 2, line 35).

flown in the face of Grover and have nevertheless surprisingly achieved success.

Moreover, evidence is present in Grover which also teaches away from the present invention, attention being invited to slurries 20 and 21 of Table 4, column 9 of Grover. In these two examples, the quantity of Grover's critical components (in that example the percentage of ammonium cerium nitrate) was insignificant, but the slurry did contain 4% by weight of silica. The selectivity was very low, under 5. This evidence teaches away from following Jacquinet, and teaches away from the present invention. Certainly, there would have been no reasonable expectation of applicants' results from a consideration of slurries 20 and 21 in Table 4 of Grover, and it must be concluded that applicants' results are unobvious from the prior art.

Bearing in mind that the surfactant of Grover is optional, and is not used in any of the Grover slurry examples, and further in view of the fact that Grover makes no teaching whatsoever that such a surfactant has any ability to improve the oxide to nitride selectivity of a CMP slurry, and further bearing in mind that Grover teaches that other components are necessary to achieve such a result (which components are not used in the present invention), the addition of a surfactant not only would not have been prima

facie obvious to the person of ordinary skill in the art in order to obtain the desired objective of increasing the oxide to nitride selectivity, but in addition, there is not the remotest hint in the prior art that the addition of a surfactant would provide applicants' improved results.

To restate this latter point, the addition of a surfactant to the Jacquinet composition provides unexpected effects, i.e. the selective polishing of silicon oxide relative to silicon nitride, which could not have been predicted or foreseen from the prior art.

The prior art rejection is unjustified. It should be withdrawn, and such is respectfully requested.

Favorable reconsideration and allowance are earnestly solicited.

Respectfully submitted,

BROWDY AND NEIMARK, P.L.L.C.
Attorneys for Applicants

By



Sheridan Neimark
Registration No. 20,520

SN:jaa
Telephone No.: (202) 628-5197
Facsimile No.: (202) 737-3528
G:\BN\R\RINU\jacquinot7\pto\amd DEC02.doc